

# **FULFILLING THE PROMISE: THE OCCOQUAN WATERSHED IN THE NEW MILLENNIUM**

**Report to the Fairfax County Board of Supervisors by the  
New Millennium Occoquan Watershed Task Force**



**January 27, 2003**

## FOREWORD

On July 26, 1982, the Board of Supervisors approved a downzoning of more than 41,000 acres in the Occoquan Watershed in Fairfax County and additional protections on about 64,500 adjacent acres. It was a process driven by citizens who cared about the County in which they live and who were willing to put in long hours to study the issues, to generate support, and to attend public hearings. During 2002, our Board commemorated the 20<sup>th</sup> Anniversary of this significant action that protected a source of one of our most vital natural resources -- our drinking water. As part of the celebration, the Board has honored those citizens and our County and regional agency staff who participated in the 1982 action and recognized those who are stewards of the Watershed today. We have published an informational brochure, and a video, *Occoquan*, has been created that tells the remarkable story.

The Board also established the New Millennium Occoquan Watershed Task Force of citizens, County staff, and regional agency representatives to look at the issues in the Watershed -- how they're the same, how they're different -- from 20 years ago. Their report, *Fulfilling the Promise - The Occoquan Watershed in the New Millennium*, presents recommendations to us about things that need to be done in order to maintain the high water quality in the Occoquan Reservoir and Watershed now and in the future.

We must remain vigilant. Twenty years ago our citizens rallied for an important cause. Because of their dedication, and with continuing community participation and County staff and agency expertise, we have ensured a protected source for safe drinking water. This is an important part of the quality of life we enjoy in Fairfax County today.

Katherine K. Hanley, Chairman  
Fairfax County Board of Supervisors  
January 27, 2003

# **FULFILLING THE PROMISE: THE OCCOQUAN WATERSHED IN THE NEW MILLENNIUM**

## **Report to the Fairfax County Board of Supervisors by the New Millennium Occoquan Watershed Task Force**

January 27, 2003

### **TABLE OF CONTENTS**

I. INTRODUCTION.....	1
II. TASK FORCE PROCESS.....	3
III. HISTORY OF THE RESERVOIR AND EVENTS LEADING TO THE 1982 DOWNZONING.....	5
IV. WHO AND WHAT PROTECTS THE OCCOQUAN: AN OVERVIEW OF THE EXISTING INSTITUTIONAL AND REGULATORY FRAMEWORK .....	11
A. Direct Reservoir Management .....	11
1. Fairfax County Water Authority .....	11
2. Occoquan Watershed Monitoring Lab.....	12
3. Upper Occoquan Sewage Authority .....	12
B. Watershed Management.....	12
1. Data Gathering and Monitoring .....	13
2. Planning for the Future .....	14
3. Regulation .....	15
4. Public Involvement and Outreach .....	16
C. New Regulatory Challenges.....	16
V. RESERVOIR AND WATERSHED PROTECTION.....	18
A. The Reservoir: Have We Successfully Protected Our Drinking Water Supply?.....	18
1. Reservoir Water Quality Trends .....	18
2. Reservoir Storage Capacity .....	22
3. Future Concerns.....	24
B. The Watershed.....	26
1. Health of the Watershed's Streams and Aquatic Ecosystems .....	26
a) Assessment of Stream Ecological Health.....	26
b) Threats to Ecological Integrity of Streams.....	27
c) Future Concerns.....	30

d) Tools for Reducing Impacts on Stream Ecosystems .....	31
2. Land Use and Open Space- The Key to Both Reservoir and Watershed Protection .....	34
a) The Zoning, Planning, and Existing Land Use Context .....	36
b) The Open Space/Stream Valley Preservation Context .....	38
c) Development Potential in the R-C District .....	40
d) Development Potential Outside the R-C District .....	43
3. Impervious Surfaces .....	47
4. Tree Cover .....	49
5. Erosion and Sediment Control and Stormwater Management .....	51
6. Onsite Sewage Disposal .....	53
a) Maintenance and Management of Onsite Sewage Disposal Systems/ Alternative Wastewater Treatment Systems .....	53
b) Future Concerns .....	55
VI. WATERSHED STEWARDSHIP .....	58
A. Citizen Education .....	58
B. Citizen Volunteers .....	59
C. Citizen Roles in Reporting and Enforcement .....	61
VII. REGIONAL COORDINATION .....	62
VIII. SUMMARY AND CONCLUSIONS .....	63

## APPENDICES

TASK FORCE MEMBERS AND PRESENTERS .....	A
BOARD OF SUPERVISORS RECORD .....	B
OCCOQUAN POLICY .....	C
OCCOQUAN BASIN STUDY – EXECUTIVE SUMMARY .....	D
R-C DISTRICT AND THE WATER SUPPLY PROTECTION OVERLAY DISTRICT .....	E
LIST OF ACRONYMS AND TERMS .....	F

## FIGURES

Figure 1 The Occoquan Watershed .....	1
Figure 2 Fairfax County's portion of the Occoquan Watershed, showing the 1982 Downzoned area .....	2
Figure 3 Microcystis bloom in the vicinity of Jacob's Rock in 1969 .....	5

Figure 4	Microcystis bloom in the Bull Run arm of the Occoquan Reservoir In summer 1973 .....	6
Figure 5	Boat wake in Microcystis bloom near Jacob's Rock in summer 1973 .....	6
Figure 6	Aerial view of the confluence of Bull Run and Occoquan Creek in fall 1977 .....	6
Figure 7	Seasonal time series of total phosphorus in Occoquan Reservoir Inflows and outflows, 1973-1999 .....	18
Figure 8	Seasonal time series of TKN in Occoquan Reservoir inflows and Outflows, 1973-1999 .....	19
Figure 9	Seasonal time series of oxidized nitrogen in Occoquan Reservoir inflows And outflows, 1973-1999 .....	20
Figure 10	Annual runoff loads of nutrients and sediment in the Occoquan Watershed As a function of rainfall, 1983-2001 .....	20
Figure 11	Predicted and observed trend in summer average Chlorophyll a in The Occoquan Reservoir .....	22
Figure 12	Site condition ratings for Occoquan subwatersheds .....	29
Figure 13	Percent imperviousness versus Index of Biotic Integrity in Fairfax County .....	48

## FINDINGS AND RECOMMENDATIONS

RESERVOIR .....	24
STREAMS AND ECOSYSTEMS .....	32
LAND USE AND OPEN SPACE .....	45
TREE PRESERVATION .....	51
EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT .....	53
ONSITE SEWAGE DISPOSAL .....	56
CITIZEN INVOLVEMENT .....	61
REGIONAL COORDINATION .....	63



# **FULFILLING THE PROMISE: THE OCCOQUAN WATERSHED IN THE NEW MILLENNIUM**

## **Report to the Fairfax County Board of Supervisors by the New Millennium Occoquan Watershed Task Force**

January 27, 2003

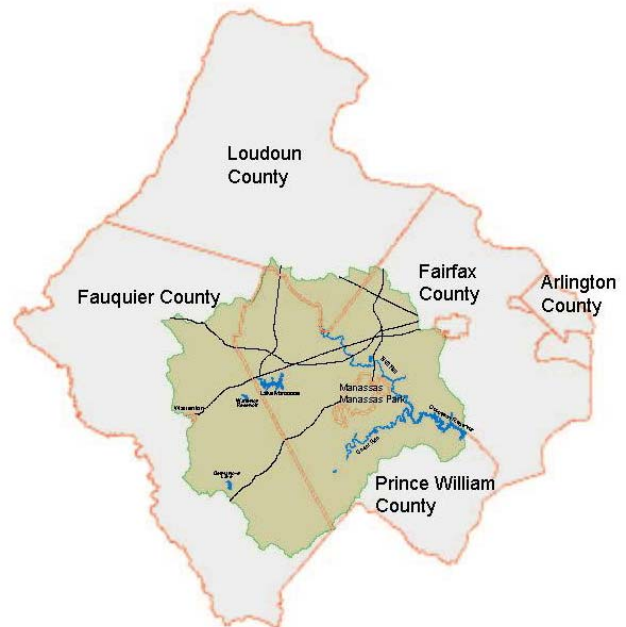
### **I. INTRODUCTION**

On July 26, 1982, the Fairfax County Board of Supervisors voted to downzone nearly 41,000 acres in the Occoquan Watershed to protect the County's water supply. On March 18, 2002, the Board of Supervisors put in motion a year-long celebration in honor of the 20th anniversary of this land mark decision.

The Occoquan Watershed, which lies in the southwest portion of the County, consists of all the land, including tributary streams, draining into the Occoquan Reservoir, the Watershed's largest body of water. Seventeen percent of the Watershed, or roughly 64,500 acres, lies in the County. The rest of the 590 square-mile Watershed lies in parts of Prince William, Fauquier, and Loudoun counties. Figure 1 shows the Watershed in relation to the region. Figure 2 provides a detail of Fairfax County's portion of the Occoquan Watershed.

As part of the 20th anniversary celebration, the Board established a New Millennium Occoquan Watershed Task Force "to provide an assessment of issues facing the Fairfax County portion of the Occoquan Watershed, to examine gaps in programs not being carried out by local, State, and regional agencies, to define the role of volunteer organizations that have interests in the watershed, and to provide a vision for the future management of the watershed." In order to help the County fulfill this new vision, the Task Force was also directed to "develop management options for consideration at the County level, as well as options for consideration as part of a regional watershed planning effort."

**Figure 1. The Occoquan Watershed.**  
(Source: NVRC)

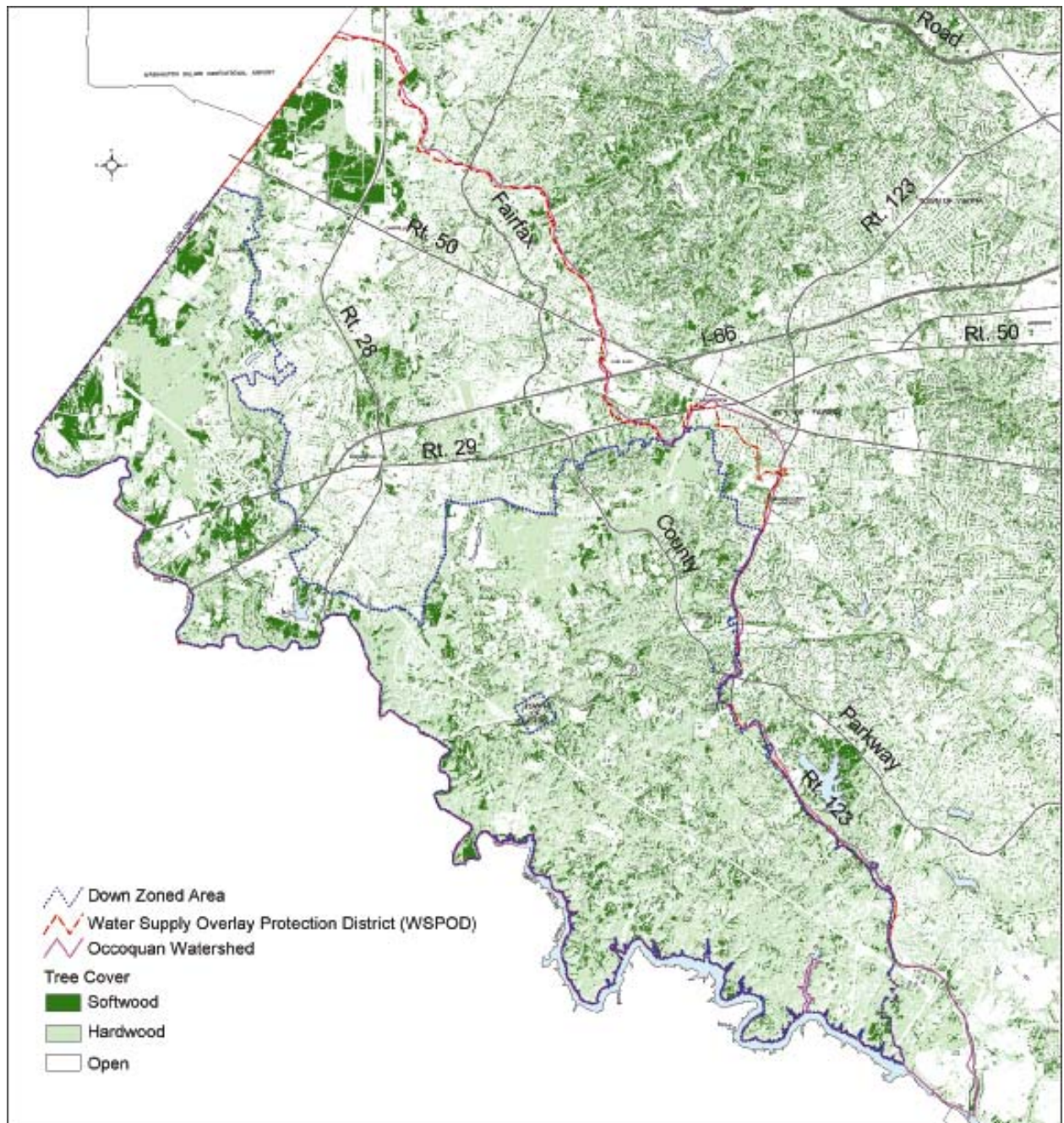




### New Challenges for a New Millennium

Since 1982, the population of Fairfax County's portion of the Watershed has grown significantly, and areas such as Centreville and Chantilly have become bustling centers for commerce and industry. According to U.S. Census data, the population of Centreville alone was 48,661 in 2000, which is almost double the 1990 population of 26,585. Over 48% of homes in Centreville have been built since 1990, while over 85% have been built since 1980.

Figure 2. Fairfax County's portion of the Occoquan Watershed, showing the 1982 downzoned area.





This growth, and its associated increase in impervious surface area, has created a host of new concerns for managing the Occoquan Watershed. For instance, the physical condition of the Watershed's tributaries has been identified as an emerging issue. Increased stormwater runoff from impervious surfaces flows into streams and creeks at a higher volume and velocity. The result is increased erosion of headwaters, blown-out banks, and down-cutting. Sensitive aquatic species can no longer live in many of the Watershed's streams – leaving a degraded aquatic ecosystem.

At the same time, there is growing recognition that the Watershed itself is more than just a source of water for the Reservoir. In addition to its role as an integral part of the drinking water system for approximately 1.2 million Northern Virginians, the Reservoir and the Watershed also provide the following benefits:

- The Reservoir protects water quality in the Potomac River and the Chesapeake Bay by trapping sediments and nutrients. According to the Occoquan Watershed Monitoring Lab (OWML), between 1983 and 1999, the Reservoir retained or converted 34% of total nitrogen, 56% of total phosphorus, and 83% of total sediment.
- The downzoned portion of the Watershed serves as a natural water treatment system, provides high quality ecological habitat, offers low-impact recreation, and supports low-density residential development as well as various public, semi-public, and agricultural uses.
- Areas of the Watershed outside the downzoned area support a wide range of important residential, commercial, and industrial uses.
- The Reservoir is a highly utilized regional recreational asset.

The challenge facing the County and region is how to best manage the Reservoir and the Watershed recognizing the primary benefit of the Reservoir as a reliable source of safe, clean drinking water and the importance of the Reservoir as an integrated ecological and hydrological system with multiple uses.

## **II. TASK FORCE PROCESS**

The Task Force convened on September 13, 2002 and met through December 20, 2002. Appointed by the Chairman of the Board of Supervisors, the members of the Task Force represent a wide range of interests and expertise, including local and regional government, the scientific, environmental, and academic communities, wastewater and drinking water authorities, and community and citizen groups.

To help define the challenges and identify potential solutions, the Task Force solicited the input and advice of a number of expert individuals and organizations. Presentations from guest speakers and Task Force members helped shape the Task Force's agenda and provided focus to its discussions. The following is a list of major presentation topics:

- History of the Reservoir and Events Leading to the 1982 Downzoning:  
Presentation by Robert L. Howell, former Assistant County Attorney.

- Overview of Existing Institutional and Regulatory Framework:  
Presentation by the Northern Virginia Regional Commission on State and federal mandates, County and regional activities, and community/citizen watershed efforts.
- Drinking Water Protection:  
Presentations by the Fairfax County Water Authority and the Occoquan Watershed Monitoring Lab to assess the success of efforts to protect the Reservoir as a drinking water supply and to identify future challenges to the Reservoir.
- Health of Aquatic Habitats:  
Presentations by the Fairfax County Department of Public Works and Environmental Services and the Audubon Naturalist Society's Webb Sanctuary on the health of the Watershed's aquatic habitats.
- Land Use and Open Space:  
Presentations by the Fairfax County Department of Planning and Zoning, the Fairfax County Park Authority, and the Fairfax County Department of Public Works and Environmental Services on land use and open space issues, including an overview of existing Comprehensive Plan policies, relevant overlays (Chesapeake Bay Preservation Ordinance, Parks, Environmental Quality Corridors, etc.), infill and redevelopment policies, and the "by-right," Special Permit, and Special Exception review processes.
- Onsite Sewage Disposal:  
Presentation by the Fairfax County Health Department on health and pollution issues associated with on-site sewage treatment systems in the Occoquan Watershed.
- Citizen Involvement:  
Presentation by the Northern Virginia Soil and Water Conservation District on opportunities to strengthen environmental protection through citizen involvement and education.

A full listing of Task Force members is provided in Appendix A along with a listing of individuals who gave presentations to the Task Force.

### III. HISTORY OF THE RESERVOIR AND EVENTS LEADING TO THE 1982 DOWNZONING

The story of the Occoquan Reservoir as a public water supply began in 1950, when the Alexandria Water Company constructed a 30-foot dam on the Occoquan River that impounded approximately 55 million gallons of water. In 1957, responding to the water supply needs of a growing population, a much larger dam, approximately 3,000 feet upstream from the lower dam, was constructed. In 1967, ownership of the Reservoir and associated treatment works passed to the newly-created Fairfax County Water Authority (FCWA), which continues to operate the system today. When initially constructed, the Occoquan Reservoir had an estimated storage capacity of 9.8 billion gallons, and a computed safe yield of about 50 million gallons per day (MGD). At the time of its completion, the Reservoir's 590 square mile watershed was principally of an undeveloped rural character - a condition that was felt to be likely to contribute to the long-term maintenance of a high level of quality of the impounded waters.

In 1959, after a period of unprecedented growth for Fairfax County and concern about the impact of this growth on natural resources such as the water supply, the Board of Supervisors adopted a new Comprehensive Plan as well as a Zoning Ordinance. The Plan limited development in the western two-thirds of Fairfax County to one house per every two acres of land. Many landowners fought the County's decision in court. The Virginia Supreme Court found the Board's action to be "discriminatory and exclusionary" and summarily rezoned the entire area to one house per acre of land. This was known as the "Carper Decision."

During the 1960s and the early 1970s, concern over the status of the Occoquan Reservoir and its viability as a water supply continued to grow. Eleven small, outdated wastewater treatment plants discharged high concentrations of nitrogen and phosphorus into the Reservoir. The high nutrient loads entering the Reservoir caused intense blooms of blue-green algae (cyanobacter), resulting in serious water quality problems. Those problems included frequent taste and odor episodes in finished drinking water, treatment problems associated with the presence of algal mats in the raw water, and oxygen loss and fish kills in the Reservoir.

Figure 3 shows a bloom of *microcystis* (a common species of cyanobacter) in the vicinity of Jacob's Rock in the summer of 1969. Figure 4 is a photograph of a bloom of the same species in the Bull Run arm of the Reservoir in the summer of 1973. Finally, Figure 5 illustrates a summer, 1973 *microcystis* bloom disrupted by the wake of a sampling boat near Jacob's Rock.



Figure 3. *Microcystis* bloom in the vicinity of Jacob's Rock in 1969. (Source: Metcalf & Eddy)



Figure 4. *Microcystis* bloom in the Bull Run arm of the Occoquan Reservoir in summer 1973. (Source: OWML)



Figure 5. Boat wake in *Microcystis* bloom near Jacob's Rock in summer 1973. (Source: OWML)

By the early 1970s, during low flow conditions, poorly treated wastewater from the eleven secondary treatment facilities in the Watershed represented a major part of the total inflow to the Reservoir. Figure 6 shows an aerial view of the confluence of Bull Run and Occoquan Creek in the fall of 1977, which was near the end of an extended period of drought. In the photograph, Bull Run is seen entering from the top right, and Occoquan Creek from the left. The main body of the Reservoir lies to the lower right. As seen from the exposed banks, the pool level of the Reservoir was substantially below normal, but what is most striking is the clear impact of the wastewater flows on the visual appearance of the waters of Bull Run. The high fraction of wastewater in the stream flow has imparted a grayish cast to the entire stream. In a further illustration of the impact of wastewater discharges, Virginia Tech researchers were able to isolate human enteric viruses in the Reservoir.<sup>1</sup>



Figure 6. Aerial view of the confluence of Bull Run and Occoquan Creek in fall 1977. (Source: OWML)

---

<sup>1</sup> Hoehn *et al.*, 1976.

The Virginia State Water Control Board (VSWCB) had been established in 1950 to oversee the State's environmental regulations and to grant permits associated with water supply. In 1968 and 1969, following an intensive study of water quality problems in the Occoquan Reservoir, the local governments joined with VSWCB in supporting a new, "Policy for Waste Treatment and Water Quality Management in the Occoquan Watershed."<sup>2</sup> Adopted in 1971, the "Occoquan Policy" mandated the replacement of outdated facilities with no more than three state-of-the-art advanced water reclamation plants and the creation of the independent Occoquan Watershed Monitoring Lab (OWML). A milestone in water quality management in the Commonwealth, the Policy included an implicit recognition that indirect re-use of reclaimed wastewater to supplement public water supply would become the operational norm in the Occoquan Watershed. It also recognized that extraordinary measures would be required to protect the public health in a situation where a water body was to be subjected to the competing uses of wastewater disposal and public water supply. In addressing this, the document not only specified the type of waste treatment practice to be adopted on a basin-wide scale, but it provided for an ongoing program of water quality surveillance to quantify the success of the water quality protection effort.

During the 1970s, the Northern Virginia Regional Park Authority (NVRPA) acquired 5,000 acres and created a series of contiguous parks along the Fairfax County shoreline of the Occoquan-Bull Run Stream Valley. This was in recognition that preserving a large buffer area around the Reservoir could contribute to protecting water quality. These parks continue to serve a public recreational use; act as a conservation area for forest, wetlands and wildlife; and help protect the shoreline of the Reservoir. Even before the NVRPA effort, the Fairfax County Park Authority began to acquire and operate parks in the Occoquan Watershed, eventually totaling several thousand acres. Twenty-six parks have been added since the downzoning in 1982.

In 1975, the Fairfax County Board of Supervisors adopted a revised Comprehensive Plan to replace the 1959 Plan. In the area that would be downzoned in 1982, the Plan generally recommended residential development densities that transitioned downward from Centreville, Chantilly, and Fairfax toward the southern and western boundaries of the County. The Plan map identified planned densities of 0.5-1 dwelling unit per acre (in places) transitioning downward to 0.1-0.2 dwelling units per acre and public park. The Comprehensive Plan text identified a density of one dwelling unit per five acres as the "primary development density" for much of the Watershed. However, the zoning of much of this area allowed residential development at densities up to one dwelling unit per acre.

In 1976, with funding provided by the U.S. EPA under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), the Northern Virginia Planning District Commission and the Occoquan Watershed Monitoring Laboratory conducted a series of nonpoint source and urban runoff studies in the Occoquan and Four Mile Run watersheds. The project provided some of the first land use-specific data on the physical and chemical characteristics of pollutant loads originating from a variety of rural and urban land uses. The study results were useful to Fairfax County and other local governments throughout the region in their early attempts to integrate nonpoint source and urban runoff control into their stormwater management programs. From 1980 to 1982, building on the results of the 208 study, the Metropolitan Washington Council of Governments and the Occoquan Watershed Monitoring Laboratory conducted investigations into the design and performance of urban runoff best

---

<sup>2</sup> VSWCB, 1971. Fairfax County and local governments in the Watershed worked with the Northern Virginia Planning District Commission (now NVRC), the Metropolitan Washington Council of Governments (MWCOG), and the federal government pursuant to Section 208 of the Water Pollution Control Act.

management practices (BMPs) under the auspices of the U.S. EPA Nationwide Urban Runoff Program (NURP). The data from the Metropolitan Washington project formed the basis of the BMP efficiency values incorporated into the public facility manuals in a variety of regional jurisdictions.

In 1978, the Board of Supervisors adopted a new Zoning Ordinance. The new Ordinance applied to the entire County and repealed the earlier 1959 Ordinance. The 1978 action re-zoned all of the properties in the Occoquan Basin, as well as the rest of the County. This rezoning action was not an upzoning or downzoning but merely a replacement of the previous zoning district with the most comparable zoning district in the new Zoning Ordinance. Therefore, actual allowed zoning remained greater than the planned densities in much of the Occoquan Watershed.

In the same year, the Upper Occoquan Sewage Authority (UOSA) Water Reclamation Facility (WRF) was placed in service and became the nation's largest and most successful project for the indirect reuse of reclaimed water to supplement a public surface water supply. Although there were also nonpoint sources of pollution in the Reservoir, the UOSA facility improved the condition of the Reservoir by eliminating most point source pollution discharge problems in the Watershed. The plant serves the western portions of the counties of Fairfax and Prince William that are within the Occoquan Watershed and the cities of Manassas and Manassas Park.

Fairfax County recognized that continued growth and development in the Watershed could counter the nutrient reductions in point source pollution made by the initiation of the UOSA operations. As a result, in 1979, the Fairfax County Board of Supervisors, as part of the Annual Plan Review, adopted a Plan Amendment (79-CW-4E) that directed staff to complete an Occoquan Basin Study focusing on nonpoint source contamination. The Plan Amendment stated the following:

*Recent studies have demonstrated that nonpoint sources of pollution contribute to deteriorating water quality in the Occoquan Reservoir. This diffuse source of land use related pollution has taken new significance with the completion of the UOSA advanced wastewater treatment plant. The 1978 opening of UOSA mitigates a major point source of pollution in the Occoquan. Therefore, water quality problems in the future will be influenced substantially by pollutant loads associated with stormwater runoff. At this time the County does not have a comprehensive policy approach for handling the problems of nonpoint pollution. However, now that the magnitude of the problem is understood, such an approach is necessary. In 1979, the County planning staff will undertake a study of the relationship of land use to water quality in the Occoquan. This study will include a re-evaluation of land use designations currently adopted in this watershed. In addition the applicability of technical strategies such as best management practices for nonpoint pollution control will be assessed. Products of this study may include recommendations for further revisions to the plan and/or revisions to the Public Facilities Manual. (Also Item 79-CW-4E quoted in Memo to Fairfax County Board of Supervisors as amended, January 28, 1980)*

On January 14, 1980, the Board of Supervisors officially authorized the Occoquan Basin Study and appointed "The Citizens Task Force on the Occoquan Basin." Its members included representatives from each of the then eight magisterial districts and from the following organizations: Dulles Airport Noise Impact Study Committee Task Force; Environmental Quality Advisory Council (EQAC); Fairfax Bar Association; Fairfax County Chamber of Commerce; Fairfax County Federation of Citizens Associations; League of Women Voters of the Fairfax

Area; Northern Virginia Board of Realtors; Northern Virginia Building Industry Association (NVBIA); and the Tree Commission. The principal water quality concern was determined to be accelerated eutrophication caused by nonpoint source pollution. The work program included the following tasks:

- Determine the effects of development as projected by the adopted plan on water quality in the Occoquan Watershed;
- Determine the effects of alternative plan options for the Occoquan Basin that would modify the adopted plan to conform to land use and noise policies;
- Dulles Airport aircraft noise impact area delineation;
- Assure water quality protection in the Occoquan Basin;
- Realize economic development benefits from land with existing and planned access to major arterials, such as I-66, without causing detrimental effects on existing and planned residential environments; and,
- Identify and test effective and practical implementation strategies to protect the water quality in the Fairfax County portion of the Occoquan Basin.

In 1979 and 1980 the Board of Supervisors also authorized a staff study to run concurrently with the work of the Task Force to develop several “scenarios” for future development of the Occoquan Watershed and to explore the feasibility and effectiveness of stormwater management best management practices (BMPs).

On March 8, 1982, the Task Force's report (Occoquan Basin Study) was transmitted to the Board of Supervisors and the public. The Report recommended that the best way to protect the Watershed from the impact of stormwater runoff would be a land use zoning density of one residence per five acres in about two-thirds of the Watershed, while stringent stormwater BMPs would be necessary in the remaining urbanized areas. In May and June, Comprehensive Plan amendments went forward to the Planning Commission and the Board incorporating recommendations of the Task Force and suggesting land use changes for the Comprehensive Plan. At the same time, public information meetings were held on the Task Force report findings. The Plan was amended on June 15, 1982.

On July 26, 1982, the Board of Supervisors also took several zoning actions consistent with the recommendations of the Task Force report, including the downzoning of nearly 41,000 acres of land in the Watershed to the Residential-Conservation (R-C) District, or one dwelling unit per five acres.<sup>3</sup> In this area, sanitary sewer service is generally not provided and public water

---

<sup>3</sup> List of Actions included:

- Amending the Zoning Ordinance to reduce the minimum yard requirements in the R-C District and allowing cluster by Special Exception in the R-C District;
- Amending the Zoning Ordinance to establish the Water Supply Protection Overlay District (WSPOD);
- Amending the Zoning Ordinance to revise the existing Airport Noise Impact Overlay District;
- Adopting amendments to Sec. 1-20A of the Public Facilities Manual to strengthen BMP requirements;
- Establishing a Technical Committee consisting of County staff, professional engineers, and planners from the private sector to study and furnish recommendations on changes to the Public Facilities Manual to provide for rural subdivision standards in areas such as those proposed for R-C cluster zoning.
- Establishing a new permit category to allow Board of Zoning Appeals (BZA) consideration of minimum yard modifications and setting a special low fee for affected home-owners;
- RZ 82-W-051 – Water Supply Protection Overlay District - placed on all lands within Fairfax County's portion the Occoquan watershed, as advertised (over 63,000 acres);
- RZ 82-W-052 – Applied the Airport Noise Impact Overlay District to lands near Dulles Airport (over 17,000 acres);



supply services are not extensive. In addition to the downzoning, the Board created a Water Supply Protection Overlay District (WSPOD), implementing strict stormwater controls on approximately 63,000 acres.<sup>4</sup> The wisdom of this action was confirmed as a necessary measure when the State Water Control Board announced later in the year that the phosphorus and nitrogen levels in the Occoquan Reservoir made it the second most polluted lake in Virginia.

A consortium of 39 real estate developers sued the County. *Amicae Curiae* (Friends of the Court) in support of the County during the Circuit Court trial included: the Fairfax County Federation of Citizens Associations, League of Women Voters of the Fairfax Area, Northern Virginia Soil and Water Conservation District, Fairfax County Water Authority, Virginia Association of Counties (VACo), Loudoun County, and the Environmental Defense Fund. In one of the longest court cases at the time in the County, the Board's 1982 downzoning action was upheld in a landmark 1985 Circuit Court decision. The decision preserved the five-acre zoning in the downzoned portion of the Watershed, helping to protect the water quality of Occoquan Reservoir. It also reinforced the ability of local governments in Virginia to implement their comprehensive plans and enabled jurisdictions to effectively plan for the future.

- 
- RZ 82-W-053 – Rezoned to I-3 parcels in the areas near Dulles Airport that were most heavily affected by aircraft-related noise (over 1,600 acres); and,
  - RZ 82-W-054 – Rezoned to the R-C District lands in the southern and western portions of the Water Supply Protection Overlay District, as advertised (nearly 41,000 acres).

<sup>4</sup> The Occoquan Basin Study referenced a figure of 64,497 acres and applied the figure in water quality modeling efforts. A figure of 64,500 acres was incorporated into the Plan language that was adopted a few weeks prior to the downzoning. The actual acreage applied to the Water Supply Protection Overlay District (RZ 82-W-051) was 63,118 acres.

## **IV. WHO AND WHAT PROTECTS THE OCCOQUAN: AN OVERVIEW OF THE EXISTING INSTITUTIONAL AND REGULATORY FRAMEWORK**

As outlined in the previous section of this report, the original strategy for protecting water quality in the Reservoir consisted of a multi-tiered approach in cooperation with the federal government, the State, adjacent counties, and regional bodies, and was based on the premise that both point and nonpoint sources of pollution contributed to water quality degradation. Primary point source pollution control strategies included:

- 1) the 1971 Occoquan Policy;
- 2) shutting down the eleven small treatment plants; and,
- 3) operation of the regional Upper Occoquan Sewage Authority Water Reclamation Facility beginning in 1978.

Nonpoint source pollution control strategies included:

- 1) the 1982 Occoquan Basin Study;
- 2) the downzoning of nearly 41,000 acres of the Watershed to serve as a natural water treatment system;
- 3) preservation of large areas of open and green space through the Fairfax County Park Authority and the Northern Virginia Regional Park Authority; and,
- 4) development of stormwater BMP requirements.

Today, these efforts have been expanded and supplemented through new technologies, the implementation and enforcement of County-wide water quality protection measures, and the active engagement of citizens and community organizations. New federal and State mandates, such as the Virginia Chesapeake Bay Preservation Act of 1988, have required the establishment of new programs and have taken water quality management in new directions. As a result, management of the Occoquan Reservoir and Watershed is ever changing and those responsible for its protection are constantly rising to new challenges. The following is an overview of current institutions involved in managing the Occoquan Reservoir, County-wide regulations and programs that are applicable to the Occoquan Watershed, and new mandates that will help to shape management in the future.

### **A. Direct Reservoir Management**

The Fairfax County Water Authority (FCWA), the Occoquan Watershed Monitoring Lab (OWML), and the Upper Occoquan Sewage Authority (UOSA) are the primary agencies responsible for direct management of the Reservoir. The Northern Virginia Regional Park Authority and the Virginia Department of Environmental Quality (through its regulatory authority) also have responsibility for some aspect of direct Reservoir management.

#### **1. Fairfax County Water Authority**

The Fairfax County Water Authority employs a number of strategies to ensure the continued health and reliability of the Reservoir. FCWA monitors chemical, physical, and biological water quality throughout the Reservoir. Based on the monitoring results, FCWA may use different treatment strategies during the water treatment process or

directly at the Reservoir, including aeration to prevent bottom waters from reaching anoxic levels or the application of an algaecide to control the levels of blue-green algae present in warmer months. The FCWA's Board of Director's Water Quality Committee develops and reviews policies related to protecting source waters and maintains a grant program that places emphasis on educational and watershed protection activities.

In response to the evolution of more stringent drinking water regulations, the FCWA has undertaken the construction of a new treatment facility on a site formerly occupied by the Lorton Correctional Facility. When completed, the Fred P. Griffith Water Treatment Plant will represent the state-of-the-art in water treatment, and will enable the Authority to remove from service some of the original facilities that date back to the 1950s.

## **2. Occoquan Watershed Monitoring Lab**

The Occoquan Watershed Monitoring Lab employs a full-time staff to monitor for a host of organic and chemical pollutants, including but not limited to COD, TN, MBAS, TSS, TP, turbidity, and a number of SOCs.<sup>5</sup> OWML maintains a network of seven rain gaging stations in the Watershed, nine stream gaging and sampling stations, and nine Reservoir sampling stations. The stream sampling stations are configured with equipment and instrumentation to allow the automatic retrieval and storage of samples during all storm events. The analytical results of such samples, combined with streamflow data, allow OWML to make accurate calculations of loads of various chemical constituents.

## **3. Upper Occoquan Sewage Authority**

The Upper Occoquan Sewage Authority's management of the Reservoir consists primarily of providing a high quality inflow stream into Bull Run, contributing to the overall quality of the Reservoir and the increased reliability of the Reservoir's capacity. Today, the average inflow into the Occoquan Reservoir is 370 million gallons per day, of which UOSA contributes approximately 25 million gallons per day (about five percent). The treated wastewater is generally cleaner than water entering through the Reservoir's tributaries, and therefore actually improves water quality in the Reservoir.

# **B. Watershed Management**

Many Fairfax County Government agencies as well as many organizations within the County are involved in promoting water quality and habitat protection in the Occoquan Watershed. Some of the agencies and organizations involved are the Department of Public Works and Environmental Services (DPWES), the Department of Planning and Zoning, the Fairfax County Health Department, the Northern Virginia Soil and Water Conservation District (NVSWCD), Fairfax County Office of the Virginia Cooperative Extension, the Fairfax County Park Authority, the Northern Virginia Regional Park Authority, the Environmental Quality Advisory Council (EQAC), the Tree Commission, the County Attorney's Office, and the Northern Virginia Regional Commission (NVRC). These agencies and organizations are responsible for implementing both Occoquan-specific and County-wide regulations and programs designed to protect water quality and habitats, or in the case of EQAC and the

---

<sup>5</sup> Chemical Oxygen Demand (COD), Total Nitrogen (TN), Methylene-blue-active substances (MBAS), Total Suspended Solids (TSS), Total Phosphorus (TP), Synthetic Organic Compounds (SOCs).

Tree Commission, for advising the County's Board of Supervisors on environmental issues facing the County, including those related to the Occoquan Watershed.

To better focus the County's stormwater and watershed planning efforts, the Stormwater Planning Division (SWPD) of the DPWES was created in 2000. Among the SWPD's primary objectives are to develop comprehensive stormwater management plans and to review current County-wide policies affecting the ecosystem and stormwater management issues. The SWPD is working to develop a framework to address the overall environmental goals and objectives of the County and to ensure a link among the planning phase, design regulations and standards, construction practices, and maintenance efforts. Representatives of the SWPD, Maintenance and Stormwater Management Division (MSMD), and several other agencies within DPWES have formed the Stormwater Management Core Team (STW) to provide broad leadership on stormwater issues.

The County's water quality protection efforts are extensively documented in the EQAC's *Annual Report on the Environment*, the County's 2001 *Stream Protection Strategy Baseline Study*, and in the *Annual VPDES MS4 Report for Fairfax County to the Virginia Department of Environmental Quality*. The latter document is a requirement of the County's permit, issued by the Virginia Department of Environmental Quality, to discharge stormwater into State waters through its municipal separate storm sewer system (MS4). This is a particularly important regulatory program in that it requires the County to develop and implement a Stormwater Management Plan to eliminate the introduction of pollution into the storm sewer system to the Maximum Extent Practicable (MEP).

The following is a summary of major County-wide regulations, programs, and initiatives that directly benefit the Occoquan Watershed and Reservoir. They are organized into four key functions: (1) data gathering and monitoring; (2) planning for the future; (3) regulation; and (4) public involvement and outreach. Most of these regulations, programs, and initiatives are discussed in greater depth later in this report.

## **1. Data Gathering and Monitoring**

Obtaining a solid basis for decision-making is critical to making policy and regulatory decisions regarding the Occoquan Watershed. Among the County's oldest and most comprehensive monitoring programs, the Department of Health's Division of Environmental Health has conducted a stream water quality program since 1969. Currently, 85 sites within 25 of the County's 30 watersheds are sampled twice a month. The primary objective of the program is to monitor the water quality of County streams and assess the potential human health risk associated with fecal coliform bacteria. This information is also used to locate pollution sources and to initiate corrective action.

While the Health Department's program focuses on water quality testing, the County launched a Stream Protection Strategy (SPS) program in 1998 to assess the physical stability and ecological integrity of major streams and tributaries within the 30 watersheds in the County. Field sampling has been conducted annually since 1999 and 25% of original sites are monitored each year. The results from the original baseline assessment completed in 2000 were used to identify, rank, and prioritize County streams. Broad management categories and strategies were subsequently developed for future restoration and/or preservation efforts on a sub-watershed basis. The SPS Baseline Study was published in January 2001 and is available on the County's website.

The Northern Virginia Soil and Water Conservation District's Volunteer Stream Monitoring Program supplements the SPS program and provides other services to the environmental community in Fairfax County. The volunteer monitoring program has active sites monitored by trained monitors throughout the County. In 2001, 35 monitoring sites were active during the winter, 30 sites were active during spring, 61 sites were active during summer, and 36 sites were active during fall.

Recognizing the increasing role of the DPWES Stormwater Planning Division in watershed management and monitoring, the SWPD is currently preparing a comprehensive water quality monitoring plan that will incorporate the Health Department's stream monitoring program by June 2003. Combining the stream monitoring activities of the Health Department with those of the SWPD will place all County stream monitoring activities into one agency. This will result in more efficient coordination of County and volunteer water quality data collection efforts and allow for more informed decision making that will be required in the development of watershed management plans.

## **2. Planning for the Future**

One of the County's most important planning tools is the Comprehensive Plan, which consists of a County-wide Policy Plan and four Area Plans. The Policy Plan provides guidance on environmentally sensitive areas, including Environmental Quality Corridors (EQCs). The Area III Plan (and, to a much lesser extent the Area II Plan) provides guidance on development of land in the area encompassing the Occoquan R-C District and a portion of the Occoquan Watershed.

In a major step forward in planning for water quality and habitats, Fairfax County is moving aggressively to develop and implement watershed management plans for each of the County's 30 watersheds. As an extension of the SPS process noted above, watershed management plans will allow the County and affected stakeholders to plan for the needs of specific watersheds based upon unique features and challenges. The first phase of the process will consist of a detailed stream physical assessment of the entire County over an anticipated one-year time frame. The second phase will be the development of detailed watershed management plans for selected watersheds sequenced over the next five to seven years.

Another important planning effort affecting the Occoquan Watershed was the "Infill and Residential Development Study" requested by the Board of Supervisors in May 1999. During the last decade, development patterns in the County and the Occoquan Watershed have been increasingly characterized by infill development. While the Study was County-wide in scope, many of the stormwater management and erosion and sediment control elements of the Study have direct relevance to the Occoquan Watershed. The Study reviewed the effectiveness of current policies and practices regarding erosion control and storm drainage with the multiple goals of minimizing impacts of stormwater runoff from a proposed development on downstream properties, limiting the impacts of stormwater management facilities on neighborhoods, ensuring that developers are accountable for impacts from their developments, and upgrading existing inadequate facilities. Study recommendations were accepted by the Board of Supervisors at a public hearing on January 22, 2001.

The Northern Virginia Regional Park Authority (NVRPA) and the Fairfax County Park Authority (FCPA) actively plan to minimize the impact of park development and use on the land, environment, and community. A significant part of the NVRPA and FCPA's missions is to protect and preserve significant and sensitive natural resources. The NVRPA and FCPA acknowledge the Occoquan Reservoir as an essential regional resource and have tailored land management and stewardship strategies to protect the Reservoir. Examples of those strategies include the FCPA's preservation of an extensive Stream Valley Park network along the tributaries of the Occoquan and the NVRPA's maintenance of forested buffers along nearly the entirety of the Bull Run and the Occoquan River shorelines in Fairfax County.

Regional planning and coordination with other Watershed localities is achieved through the Occoquan Basin Nonpoint Pollution Management Program. The goal of the program is to help localities maintain acceptable water quality in the Reservoir through control of nonpoint source pollutant loadings. The Northern Virginia Regional Commission maintains the Occoquan Basin Computer Model, which during the early 1980s served as the basis for downzoning the Fairfax County portion of the Watershed to protect drinking water from pollution caused by urban development. Every five years, NVRC performs an assessment of changes in land uses in the Watershed to update the model and to help localities determine whether additional land management efforts need to be undertaken.

### **3. Regulation**

In addition to the County's Zoning Ordinance, specifically the R-C District and WSPOD requirements, the County's major water quality regulatory tools include the Erosion and Sediment Control Ordinance, the Chesapeake Bay Preservation Ordinance, and the Public Facilities Manual.

The Erosion and Sediment Control Ordinance (Chapter 104 of the Fairfax County Code) requires actions to reduce sediment deposition from construction sites and requires adequate outfalls for stormwater discharges to protect downstream properties and waters from upstream impacts.

The Chesapeake Bay Preservation Ordinance (Chapter 118 of the Fairfax County Code), or CBPO, was adopted by the Board in 1993 and was designed to protect certain areas along tributary streams designated Resource Protection Areas (RPAs). Areas outside the RPA are designated Resource Management Areas (RMAs), where BMPs are required to reduce nutrient loadings resulting from new development and redevelopment. The CBPO is enforced through the development review and inspection process. The NVSWCD develops conservation plans for agricultural lands under provisions of the CBPO as well as for Agricultural and Forestal Districts in the County.

Recent efforts by the County should result in significant strengthening of the CBPO. A project to "field identify" perennial streams in the County was initiated in early 2001 in response to Board direction, partly as a result of an EQAC resolution regarding the mapping and protection of all perennial streams under the Chesapeake Bay Preservation Ordinance. The reason behind the recommendation was that the CBPO protected only tributary streams defined as a "blue line" on a U.S.G.S. quadrangle map. However, these maps were not meant to be used for such purposes and generally underestimated the true extent of perennial streams. The effort took on added

importance when the State Chesapeake Bay Preservation Area Designation and Management Regulations were amended to mandate that all “water bodies with perennial flow” be protected by an RPA buffer area. A work group consisting of representatives from several Fairfax County agencies has evaluated the issues concerning the mapping of perennial streams and has recommended a protocol to accomplish their identification. The entire County is expected to have all headwater streams identified and mapped over a two-year time frame – by the end of 2003.

The Public Facilities Manual provides guidelines governing the design of public facilities including storm drainage, sewage disposal, erosion and sediment control, vegetation preservation and planting, and BMPs. Although the original suite of BMPs to meet the requirements of the WSPOD and later the CBPO were limited to dry ponds, wet ponds, and infiltration trenches (where soils allowed), the County has begun to expand its options and to encourage the use of design techniques aimed at reducing impervious surface cover. The incorporation of “rain gardens” (also known as bioretention or biofiltration facilities) is one example.

#### **4. Public Involvement and Outreach**

Regulation is not the only way the County implements policy. The activities of numerous organizations contribute to public awareness of watershed protection issues in Fairfax County. Programs range from public education addressing pollutants and other detriments to water quality to volunteer services in monitoring and clean up efforts. An example was the Adopt-A-Stream program initiated in June 1989 by the Health Department to promote citizen awareness of the potential hazards of recreational usage of streams and to educate citizens in identifying and reporting possible pollution problems. Participants in the program ranged from individuals, Scout groups, civic associations, and school science classes. Unfortunately, this program has not been active since 1999 due to budget constraints.

The NVSWD also conducts special programs at schools, make presentations at environmental conferences, sponsor tours, and publish a newsletter. In addition they partner with other groups in the County government, homeowners associations, County parks, and private environmental organizations.

Public involvement and outreach programs are discussed in more detail in Section VI.

### **C. New Regulatory Challenges**

New federal and State regulations have the potential to greatly affect how the Reservoir is managed. This was demonstrated by the sweeping changes ushered in by the Occoquan Policy in 1971 and the RPA requirements of the Chesapeake Bay Preservation Act in 1988 (formalized by State regulations in 1989). More recently, Fairfax County was required to obtain a Virginia Pollutant Discharge Elimination System (VPDES) permit from the Department of Environmental Quality to discharge stormwater through its municipal separate storm sewer system (MS4). Issued to the County on January 24, 1997 (State Water Control Law Permit No. VA0088587), the permit has required the County to develop a Stormwater Management Program pursuant to State and federal guidelines.



The Total Maximum Daily Load (TMDL) requirements of the Clean Water Act represent a relatively new regulatory effort that will almost certainly affect the way that the Reservoir is managed. In its basic form, a TMDL is a pollution budget established for streams that violate State water standards. In other words, a TMDL is the greatest amount of a pollutant that a waterbody can receive without violating applicable water quality standards. Background, point source, and nonpoint source loadings are considered.

TMDLs have already been developed for Accotink Creek and Four Mile Run. According to the Department of Environmental Quality's most recent list of water bodies that violate State standards (commonly known as the 303(d) report), Occoquan Watershed TMDLs will be required for Popes Head Creek (benthics<sup>6</sup>), Bull Run (benthics), and Occoquan Bay (pH and PCBs). In addition, the 2002 303(d) report lists the Occoquan Reservoir itself as impaired for dissolved oxygen (DO). While DEQ has proposed that the impairment is naturally occurring and therefore does not require the development of a TMDL, an intensive study will need to be conducted to demonstrate that the impairment is non-anthropogenic. At present, OWML, FCWA, UOSA, and NVRC are working with the State to determine the best approach to the study.

The implication for the County is that the greater degree of control at the federal and State level, the less control there is at the local level. As a result, it is very important that the County be active in the development and planning of TMDLs.

Virginia's Tributary Strategies process will also present new challenges to Fairfax County. The multi-jurisdictional 2000 Chesapeake Bay Agreement, signed by Governor James Gilmore in June 2000, commits Virginia to a host of water quality and habitat-related commitments and goals. Among the most important of these is a commitment to remove the Chesapeake Bay from the U.S. EPA's list of impaired waters by the year 2010. Such an effort will require significant additional reductions in both nutrient and sediment loads to the Chesapeake Bay. While the 2000 Chesapeake Bay Agreement is non-regulatory, failure to meet its water quality commitments could result in the imposition of a TMDL, which is regulatory in nature, on the entire Chesapeake Bay watershed.

---

<sup>6</sup> Benthics, short for benthic macroinvertebrates, refers to organisms living in, or on, bottom substrates in aquatic ecosystems. Waters may be considered impaired if monitoring indicates that benthic macroinvertebrate communities have been degraded.